

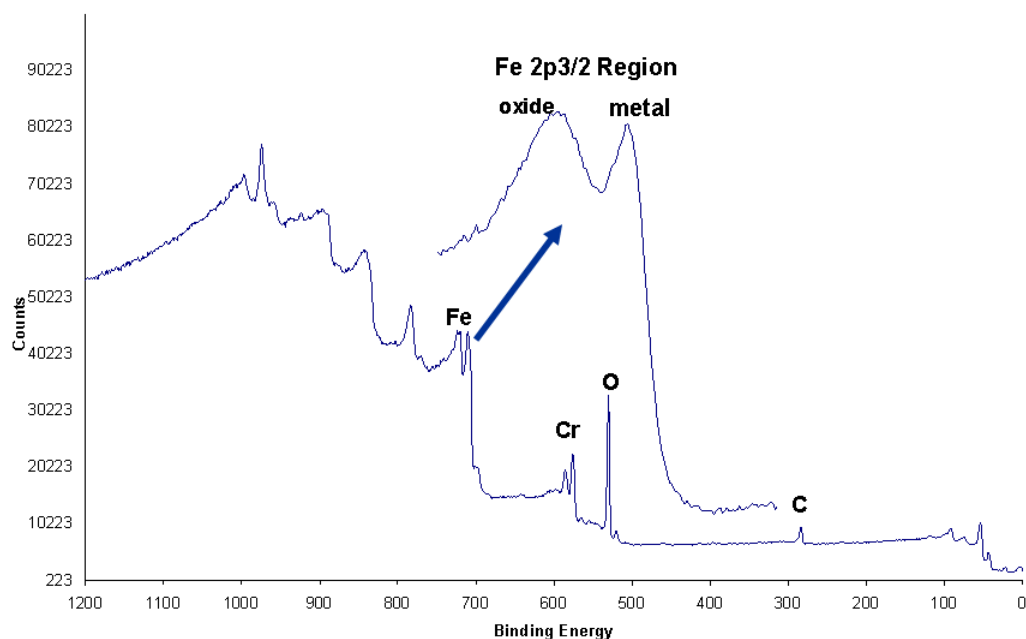
Specimen Cleaning for Spiral Orbit Tribometry at GRC

Overview.

The use of the SOT to determine relative tribodgradation rates of liquid lubricants (relative normalized lifetimes in orbits/ μg) requires a standard specimen preparation and cleaning procedure to obtain sufficiently reproducible data. The cleaning procedure at GRC has developed over the years and the following criteria have guided this development.

- the cleaned specimen must be wettable by water (zero contact angle).
- the cleaned specimen must exhibit an XPS spectrum in which features due to the usual minerals with Ca, Mg and Zn are absent and the native oxide is thin enough so that the features due to the underlying un-oxidized metal constituents appear strongly and the feature due to adventitious carbon is “weak”. Such a spectrum is shown below.

XPS Spectrum of 440C Steel Prepared for Tribotest



- the procedure should be one that industry could recognize as producing a surface that is close enough to the surfaces that they themselves produce to be regarded as a credible surface.

Note that in the GRC procedure the following are not used:

- organic solvents such as freon, acetone, hexane or alcohols
- cleaning agents with proprietary surfactants (soaps)
- plasma, ion bombardment or UV-ozone.

Procedure.

The specimen balls are usually grade 25 and are obtained commercially in the polished state. No further physical polishing is performed. The specimen plates are polished commercially by the metallography lab at GRC.

The specimen is rubbed lightly with fingers with a dilute paste of polishing alumina (Buehler Micropolish II, .05 micron de-agglomerated gamma alumina. P/N 40-6325-016) or SiC polishing powder. Best N-DEX powder-free blue Nitrile gloves are worn. After the polishing paste is removed as well as possible by rubbing lightly under a stream of de-ionized water (Barnstead NANOpure Deionization System, Type D4700, 18 M Ω water), the specimen is ultra-sonicated for a couple of minutes in de-ionized water. The specimen is then dried in a stream of nitrogen gas.

The specimen can then be inserted into the XPS system for surface analysis to produce a spectrum such as the one above. It is not feasible, of course, to perform an XPS analysis for each specimen for every test, so that it is just assumed that this procedure would produce the above XPS spectrum if it is followed.



Determination of Lubricant Mass

Balance: Capacity: 22g Readability: 2 μ g

Method: 1. Weigh clean ball

2. Lubricate ball

3. Reweigh ball

4. Take difference

Practical minimum uptake: about 20 μ g

